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Final Report

J85 COST/BENEFIT ENGINE STUDY

Submitted by

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5100 Springfield Pike
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to

US Air Force Materiel Command
San Antonio Air Logistics Center
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This report documents the results of an independent evaluation of J85 maintenance practices and the data reporting system used for parts life tracking (PLT) of selected life limited components. A major requirement of the study was to quantify the costs/benefits associated with using the D042 Comprehensive Engine Management System (CEMS) for J85 PLT versus the system now in use. The techniques and methodologies used in the analysis are compatible with the philosophy of Reliability-Centered Maintenance (RCM).

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PREFACE

TASC would like to thank the people at SA-ALC and the J85 MAJCOMs and bases for their significant contribution to this study. In particular, we wish to thank Mr. Ken Scribner (SA-ALC) for his support as our primary point of contact and Mr. John Streller (CEMS PMO, Tinker AFB) for his time and experience as our primary CEMS point of contact. We would also like to thank Mr. Jim Johnston and Major Bauer of Hq ATC along with SSgt Vega of the Randolph AFB J85 Engine Management Group for sharing their extensive knowledge of current base operations and the process for performing PLT via CAMS.

TABLE OF CONTENTS

LIST OF FIGURES

Figure **Page**

LIST OF TABLES

1. INTRODUCTION

This report documents the results of an independent evaluation of J85 maintenance practices and the data reporting system used for parts life tracking (PLT) of selected life limited components. A major requirement of the study was to quantify the costs/benefits associated with using the D042 Comprehensive Engine Management System (CEMS) for J85 PLT versus the system now in use. Additionally, the statement of work required that the techniques and methodologies used in the analysis be compatible with the philosophy of Reliability-Centered Maintenance (RCM).

SA-ALC/LPEBT's primary objective in contracting for this study was to obtain an independent analysis of the costs and benefits of performing J85 engine PLT using CEMS instead of the G054 Core Automated Maintenance System (CAMS). The output of this study is to assist SA-ALC in determining if a change in J85 PLT reporting systems is feasible.

The findings contained herein were originally presented to SA-ALC/LPEB/LPEBE/ LPEBT in a slide presentation (SP-6760-1-4) on 21 April 1993. An Executive Overview presentation of the J85 Analysis Results was also provided to SA-ALC/LPE on the same date.

1.1 J85 MAINTENANCE CONCEPT

The J85-GE-5 turbojet engine is the powerplant for the T-38 aircraft. The engine was introduced into the Air Force operational inventory in early 1961. Currently the J85-GE-5 engine is maintained by three commands; Air Training Command (ATC), Air Combat Command (ACC), and Air Force Materiel Command (AFMC).

1.1.1 Background

The J85-GE-5 engine maintenance program has some unique features that distinguish it from other engine programs. First, the engine has very few components, including major assemblies (compressor, turbine, etc.), that are not classified as Economic Order Quantity (EOQ) parts. Secondly, the J85 is maintained using a modified two-level maintenance concept. The two levels are flight line (organizational) and in-shop (intermediate) both located at base level. The base Jet Engine Intermediate Maintenance (JEIM) activities have full repair capability for the internal assemblies. These are capabilities that are generally found only at depot level. A contract depot is available at Teledyne Neosho, Mo., however, this facility primarily supports Navy and Foreign Military Sales (FMS) programs. Some Air Force engine accessory overhaul has been accomplished at the Teledyne facility. Third, the majority of the base level engine maintenance activities are contractor operated. Finally, the J85 uses CAMS (G054) to track parts life of major assemblies and internal indentured components with life limits instead of CEMS (D042).

1.1.2 Parts Tracking

The use of CAMS to do parts life tracking (PLT) instead of CEMS presents some interesting challenges to the J85 program. The major difficulty in using CAMS is that unlike CEMS, the G054 does not feed the parts life information into a central database that can be accessed by major command and depot personnel.

The J85 CEMS PLT requirement was originally in CEMS Increment II that was canceled by the Air Staff in November 1983. The requirement was resubmitted and is still pending implementation. In the interim, it was decided to use base level CAMS to perform this function for the J85 engine. To forecast parts requirements considerable manual effort is required. For example, a quarterly parts forecast must be developed to determine buy quantities. The bases must determine how many life limited parts, of what type, they will need to replace each quarter. The information is available at each base in the local CAMS

database but is not accessible by Hq personnel or SA-ALC. Hq ATC, developed a command unique CAMS application that allowed them to access and download this data to a PC for consolidation. However, a recent change to the CAMS database made this program unusable. The forecasting process is discussed in more detail in Section 2 of this report.

Safety is another factor that must be considered when looking at J85 PLT. The original life limits have been found to be over optimistic and are being reduced. Whenever a limit is reduced, base level maintenance personnel must accomplish an evaluation of the potential safety and logistics impacts of the change. The existing J85 process does not provide ready visibility of the impacts of lowering limits. SA-ALC/LPEB must contact the users and determine the location of all of the items. How many are in installed engines that are currently flying? How many are in un-installed spare engines? How many are on the shelf in supply or in the shop? This information is available in the CAMS database at base level but there is no automated way to aggregate it at MAJCOM or depot level.

SA-ALC and the using commands recognized these shortfalls and submitted the necessary documentation to include J85 PLT in CEMS. Additionally, a AFLC LOC/PN letter, 20 December 1989, on the Reliability-Centered Maintenance (RCM) Program indicated that CEMS implementation was required to meet RCM compliance requirements.

1.1.3 Reliability-Centered Maintenance (RCM) Impacts

The J85 engine program, like all of the other SA-ALC engine programs, was directed to implement the RCM/OCM concept and move from a time based maintenance concept to one based on reliability. The unique maintenance approach of this engine made it difficult to implement RCM and the J85 was later dropped from RCM implementation tracking. In July 1989 an Air Force Audit Agency Report, Project 7106213, (Reference C4a) identified the J85 as having insufficient workload to justify conversion to the RCM concept.

However, in the course of this study it was noted that the J85 is maintained under a concept that is compatible with the philosophy of RCM. Additionally, the process used by SA-ALC to update inspection intervals, life limits, and other preventative maintenance tasks is the same disciplined approach as that used by other SA-ALC engines that fall under RCM.

1.2 SCOPE

The scope of this effort was limited to the J85-GE-5 life limited modules and internal indentured parts depicted in Table 1.2-1. As noted above, the J85 engine is maintained at base level and sends parts to depot for repair only on an exception basis. Table 1.2-2 is a list of the J85 operational locations impacted by this study.

Table 1.2-1 J85 Life Limited Modules and Indentured Parts Included in Study

INDENTURE	NOMENCLATURE	INDENTURE	NOMENCLATURE
1	Engine	3	Spacer, Stg 2
2	Inner Shell	3	Spacer, Stg 3
2	Outer Shell	3	Spacer, Stg 4
2	Compressor	3	Spacer, Stg 5
3	Shaft and Seal	3	Spacer, Stg 6
3	Disk, Stg 2	3	Spacer, Stg 7
3	Disk, Stg 3	3	Labyrinth Seal
3	Disk, Stg 4	3	Drive Shaft
3	Disk, Stg 5	3	Stg. 1 Compressor Blades
3	Disk, Stg 6	2	Turbine
3	Disk, Stg 7	3	Turbine Wheel, Stg 1
3	Disk, Stg 8	3	Turbine Wheel, Stg 2
3	Spacer, Stg 1	3	Torque Ring

Table 1.2-2 J85 Operational Locations Impacted

SITE	ASSIGNED ENGINE	CMD
Beale	J85-5F, H, J, M	ACC
Columbus	J85-5F, H, J, M	ATC
Edwards	J85-5F, H, J, K, M	AFMC
Eglin	J85-5F, H, J, M	AFMC
Hill	J85-5F, H, J, M	AFMC
Holloman	J85-5L, M	ACC
Kelly	J85-5F, H, J, M	AFMC
Laughlin	J85-5F, H, J, M	ATC
McClellan	J85-5F, H, J, M	AFMC
Nellis	J85-5L, M	ACC
Randolph	J85-5F, H, J, M	ATC
Reese	J85-5F, H, J, M	ATC
Sheppard	J85-5F, H, J, M	ATC
Vance	J85-5F, H, J, M	ATC

1.3 METHODOLOGY

The primary techniques used in this study were information surveys and cost/benefit analysis. The information survey approach was used to define the analysis baseline, alternatives, and to evaluate the current and proposed PLT methodologies. The information surveys consisted of in-depth documentation reviews and interviews with key J85 base, MAJCOM, and depot personnel. Standard cost estimating techniques were used to quantify costs associated with the implementation of J85 PLT in CEMS. Process flow charts were utilized to assess the differences between using CEMS instead of CAMS for J85 PLT.

1.4 REPORT ORGANIZATION

This report is divided into three (3) sections. Section 1 is a brief overview of the contractual requirements, the J85 maintenance concept, and introduction. Section 2 presents the results of the Cost/Benefits Analysis related to the current and proposed J85 PLT methods. Section 3 provides an overall summary of the studies findings, conclusions, and some recommendations for future consideration.

2. J85 COST/BENEFIT ANALYSIS

2.1 INTRODUCTION

2.1.1 Cost/Benefit Study Objectives

The primary objective of the J85 Cost/Benefit study was to determine the costs and benefits associated with implementing J85 Parts Life Tracking (PLT) in the D042 Comprehensive Engine Management System (CEMS) versus the current method which utilizes the G054 Core Automated Maintenance System (CAMS). In addition, the report presents recommendations related to the implementation of J85 PLT in CEMS.

2.1.2 Cost Modeling Approach

An overview of the cost modeling approach used is described in Fig. 2.1-1. Inputs to the model include data from various Air Force data systems along with information from the CEMS Program Management Office (PMO) at Tinker AFB, Major Command Headquarters, and individuals at San Antonio Air Logistics Center (SA-ALC). These input data were used to drive the analysis section of the model, which consists of Cost Element Spreadsheets and Summary Spreadsheets. A cost element is defined as an identifiable function or a common group of functions which have been established as a separate entity for the purpose of estimating costs[1]. The Cost Element spreadsheets include the algorithms and resulting cost estimates for each of the cost elements impacted by the implementation of PLT in CEMS. These cost estimates, in base year 1993 dollars, are automatically linked to the Summary Spreadsheets.

In the Summary Spreadsheets, costs are consolidated for analysis purposes, and inflated to then-year dollars using inflation indices from the Air Force Cost Analysis Agency

[1]NES Dictionary of Cost Estimating Terms, National Estimating Society, Fall 1986.

(AFCAA). Sample output products are presented at the bottom of the figure. In addition to providing an electronic library of analysis data and results, the cost model also allows expedient turn around on "what if" analyses.

2.1.3 Benefit Analysis Approach

A three step process was used to assess the potential benefits associated with performing J85 PLT in CEMS. Initially, a list of potential benefits was compiled based on conversations with key J85 personnel at San Antonio, Air Training Command (ATC) Headquarters, and J85 Bases. This list of potential benefits was then analyzed closely and, where possible, detailed process flow diagrams were developed to describe the processes before and after the implementation of J85 PLT in CEMS. The third step in the benefit analysis approach compared and contrasted each of the process steps in the flow diagram and, where possible, differences between the pre-CEMS and CEMS processes were quantified in terms of cost.

2.2 ANALYSIS SCENARIO

2.2.1 Key Assumptions

The study is based on several important assumptions. Key assumptions that impact the study are:

- No additional CEMS hardware will have to be procured to implement PLT for the J85. This includes terminals at the bases, MAJCOMS, and SA-ALC as well as storage devices at Tinker for CEMS (D042).
- Existing Air Force personnel will accomplish any added effort for program management. Program management includes management resources at the CEMS PMO and SA-ALC required to manage the implementation effort. The implementation estimate includes only software related costs for the CEMS PMO. These costs are captured under the Software Investment Cost Element.

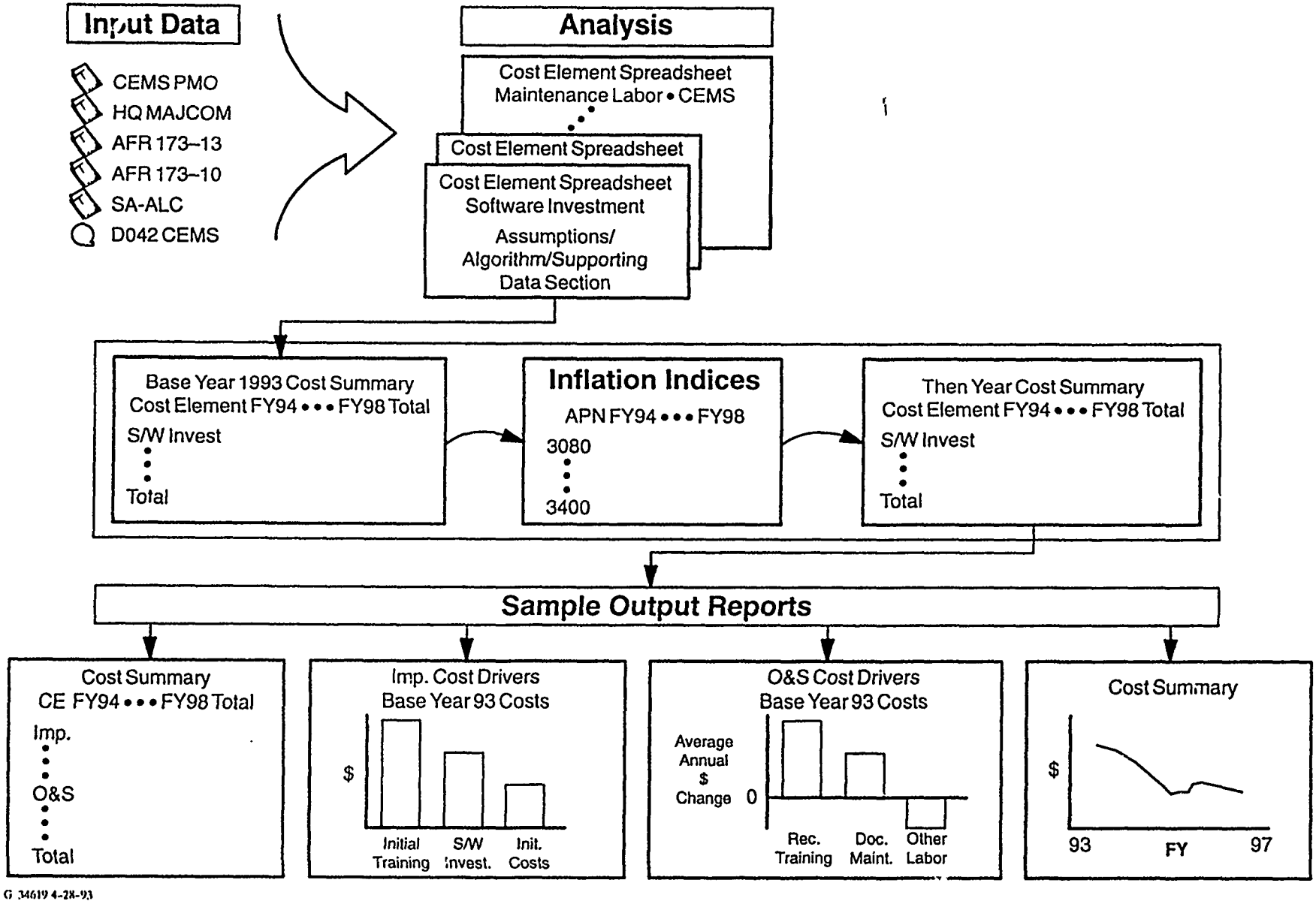

Figure 2.1-1 J85 Cost Modeling Approach

- Existing Air Force facilities will be adequate and will not require expansion or modification.

- Performing PLT in CEMS will not significantly impact the number of J85 maintenance actions. After discussions with J85 personnel at SA-ALC and Randolph AFB, it was determined that, because J85 is currently performing PLT (via CAMS data), the number of maintenance actions will not change significantly when PLT is performed in CEMS.

2.2.2 Ground Rules

The study is based on the following ground rules:

- The implementation of J85 PLT in CEMS will take place in FY94. As a result, implementation costs are shown in FY94 and recurring operation and support costs begin in FY95.

- No change in the J85 maintenance concept is envisioned.

- The study includes engines assigned to ACC, ATC, and AFMC.

- The study is limited to the J85 compressor, turbine, and their indentured parts with life limits.

2.3 BASELINE DATA

This paragraph details the baseline data that was used to support the cost estimate calculations presented in Paragraph 2.4. Table 2.3-1 presents historical J85 data from CEMS (D042), including flying hours, maintenance actions, and the average number of engines in the J85 fleet. In FY91, reductions begin to appear in all three metrics. Table 2.3-2 lists the projected maintenance actions for FY94 through FY98. The decreasing trend that began in FY91 is expected to continue through the five-year time period as the fleet downsizes.

Table 2.3-1 J85 Historical Data

ITEM	FISCAL YEAR					SOURCE
	FY88	FY89	FY90	FY91	FY92	
Flying Hours	690,545	742,680	728,337	660,446	523,761	CEMS
Maintenance Actions	4,010	4,096	4,159	4,055	3,313	CEMS
Average No. of Engines	1,950	1,950	1,950	1,650	1,650	KScribner

Table 2.3-2 Projected Maintenance Data

ITEM	FISCAL YEAR					SOURCE
	FY94	FY95	FY96	FY97	FY98	
Projected No. of Maintenance Actions (all PLT items)	2,811	2,739	2,448	2,148	2,084	SA-ALC Actuarial Staff

2.4 COST/BENEFIT FINDINGS

This paragraph presents the results of the J85 Cost/Benefit Analysis. It is divided into two major topic areas. The first area presents the Cost Analysis and Results, while the second presents the Benefit Analysis and Results.

2.4.1 Cost Analysis and Results

A tailored cost element structure was developed for J85 from standard Acquisition and Operation and Support Cost Element Structures. These structures, which included a comprehensive list of Acquisition and O&S cost elements, were refined to include only those elements that were reasonably expected to have been impacted by the J85 implementation of PLT in CEMS. This tailored structure is presented in Table 2.4-1. The remainder of this

paragraph presents the cost analysis approach and results for each of the cost elements in Table 2.4-1.

Table 2.4-1 J85 Tailored Cost Element Structure

IMPLEMENTATION COST ELEMENTS
- Software Investment - Initialization Costs (CAMS to CEMS Data Upload) - Documentation - Initial Training
O & S COST ELEMENTS
- Unscheduled Maintenance Labor (CEMS) - Scheduled Maintenance Labor (CEMS) - Recurring CEMS Cost - Documentation Maintenance - Recurring Training

2.4.1.1 Software Investment

Software Investment represents the cost to expand/modify CEMS for J85 PLT. This cost includes the number of man-hours to code, test, and configure the software, import the extracted CAMS data, along with the cost to update the CEMS user manual. The cost was estimated by multiplying the approximate number of man-hours required by a representative labor rate. The primary source of this information was Mr. John Streller of the CEMS PMO at Tinker AFB. Mr. Streller estimated that this task would take a GS-12 level person approximately 300 hours to accomplish. The results of this estimate are presented in Table 2.4-2.

As a cross check, the estimate was compared to the actual costs incurred by a Navy program to implement PLT in CEMS. The cost of the Navy program is presented in Table 2.4-3. The primary estimate of $10,395 (FY93 dollars) is significantly higher than the cross

check estimate of $2,648 (FY93 dollars). M. Streller pointed out that there are several reasons for this difference. The Navy implementation only included the cost to perform PLT at Depot level. Also, Mr. Streller identified two unique features associated with the J85 that would impact the CEMS software investment. These two features are adding a J85 base level capability to perform all maintenance tasks and condemn parts. The unique J85 requirement for these additional features result in a more complex CEMS software development effort than was required for the Navy program.

Table 2.4-2 Software Investment Primary Estimate

Source	Primary Estimate	
AFR 173-13	GS-12 Accelerated Hourly Rate	$34.65 FY93 Dollars
Mr. Streller	Number of Manhours	300
	Total Cost	$10,395 FY93 Dollars

Table 2.4-3 Software Investment Cross Check Estimate

Source	Cross Check — Navy F110-400 Engine Implementation	
CSRD MR2103-2129	Hourly Labor Rate	$25.00 FY92 Dollars
CSRD MR2103-2129	Manhours	102
	Total Navy Cost	$2,550 FY92 Dollars
AFR 173-13	APN 3400 Inflation Index	1.0384 FY92 to FY93 Dollars
	Total Navy Cost	$2,648 FY 93 Dollars

Note: The Navy effort included tracking parts at the depot level and not the base level.

2.4.1.2 Initialization

Initialization includes the cost required to transfer J85 historical data to CEMS from CAMS. The estimate assumes this transfer will be performed electronically. As a result, cost will be incurred only to write and test the software code required to perform the data extraction. This cost is estimated by multiplying the approximate number of man-hours required by an appropriate labor rate. The primary sources for this estimate were SMSgt Gurney of the CAMS PMO at Gunter AFB and Mr. Ken Scribner of Kelly AFB. SMSgt Gurney provided technical information concerning the CAMS to CEMS transfer along with a rough estimate of 40 man-hours to develop and test the process. Mr. Scribner reviewed and approved SMSgt Gurney's estimate of 40 man-hours. The results of this estimate are presented in Table 2.4-4. Cost to develop routines to upload the extracted CAMS data into CEMS was included in the software estimate discussed in paragraph 2.4.1.1.

The assumption that this initialization effort will be performed electronically is important. The alternative is to upload the CAMS data to CEMS manually. For information purposes, an estimate of this cost is provided in Table 2.4-5. This estimate was developed based on a conversation with Ms. Barbara Jones, a T56 Engine Manager at Little Rock AFB. Ms. Jones has extensive CEMS experience and was closely involved with the T56 initialization effort. While the process used by T56 was somewhat different, Ms. Jones was able to provide an estimate for the number of manhours required to initialize one item in CEMS. This estimate was then multiplied by the total number of J85 PLT items expected to exist in FY94. The total number of J85 PLT items was calculated by multiplying the expected number of engines by the number of PLT items per engine. The results of this estimate are presented in Table 2.4-5.

Table 2.4-4 Initialization Primary Estimate

Source	Primary Estimate	
SMSgt Gurney/KScribner	Number of Hours	40
AFR 173-13	Hourly Labor Rate (GS-12)	$34.65 FY93 Dollars
	Total Cost	$1,386 FY93 Dollars

Table 2.4-5 Alternate Initialization Estimate

Source	Alternate Estimate	
KScribner	No. of PLT Items/Engine	23
KScribner	Total No. of Engines	1,650
CEMS	Estimated Total No. of Items	37,950
Ms. BJones (LRAFB)	Time to initialize one item	1 Minute
	Total Time Required	633 Hours
AFR 173-13	Hourly Labor Rate (E-3)	$15.08 FY93 Dollars
	Total Cost	$9,546 FY93 Dollars

2.4.1.3 Documentation

The third cost element listed in Table 2.4-1 is documentation. This element includes the cost for any new or modified documentation required as a result of the implementation of J85 PLT in CEMS. After reviewing the effort required with SA-ALC/LPEBT and the CEMS PMO, it was determined that the cost would be minimal. It is anticipated that updates to the CEMS User Manual (TO 00-25-254) and J85 PLT procedures (TO 00-5-1-X) will take less than one man-day because the documentation is stored in an electronic version. Because of the limited nature of this task, a cost estimate was not included in this report.

2.4.1.4 Initial Training

Initial Training includes the cost to train the initial group of J85 personnel to use CEMS for PLT. Mr. John Streller of the CEMS PMO, advised that there is no cost for this training course (i.e., materials, etc.). As a result, the only costs associated with initial training are per diem and travel costs to Tinker AFB, where the classes are held. Also, the Scheduled Airlines Travel Office (SATO) at SA-ALC advised that rental cars are not authorized for this type of training. The total cost was estimated by multiplying the cost per person per trip by the total number of trips, where the cost per person per trip equals round-trip air fare plus per diem multiplied by the number of course days (3). Table 2.4-6 summarizes the results of this estimate. The number of personnel to be trained was provided by Mr. Ken Scribner (SA-ALC/LPEBT) and Major Bauer (Hq ATC). Travel costs were obtained from the SATO.

Table 2.4-6 Initial Training

Base	Command	No. of people to be trained		(Source of Cost Data: SATO)			Total Cost
		Source	Number	Air Fare	Per Diem (3 days)	Car Rental	
Beale	ACC	KScribner	0	$296	$225	0	$0
Columbus	ATC	Major Bauer	3	$390	$225	0	$1,845
Edwards	AFMC	KScribner	3	$270	$225	0	$1,485
Eglin	AFMC	KScribner	3	$668	$225	0	$2,679
Hill	AFMC	KScribner	3	$346	$225	0	$1,713
Holloman	ACC	KScribner	3	$318	$225	0	$1,629
Kelly	AFMC	KScribner	0	$158	$225	0	$0
Laughlin	ATC	Major Bauer	3	$158	$225	0	$1,149
McClellan	AFMC	KScribner	0	$296	$225	0	$0
Nellis	ACC	KScribner	3	$280	$225	0	$1,515
Randolph	ATC	Major Bauer	5	$158	$225	0	$1,915
Reese	ATC	Major Bauer	3	$286	$225	0	$1,533
Sheppard	ATC	Major Bauer	3	$228	$225	0	$1,359
Vance	ATC	Major Bauer	3	$0	$225	0	$675
Total Cost for Initial Training at Tinker AFB (FY93 Dollars)							$17,497

2.4.1.5 Maintenance Labor CEMS Data Entry

Maintenance Labor (Scheduled and Non-Scheduled) includes costs incurred for J85 maintenance personnel to enter PLT data into CEMS. The assumption stated earlier that the implementation of J85 PLT in CEMS will not significantly impact the number of maintenance actions plays an important role in this cost element. Because there will not be a significant change in the number of maintenance actions, *the only change in maintenance labor will be the additional paperwork and data entry required by CEMS.* Based on discussions with key personnel for J85 and T56 (utilizing T56 personnel's CEMS experience), the estimate assumes no CAMS data entry or paperwork will be discontinued when J85 CEMS PLT is implemented.

The primary sources for this estimate were discussions with T56 base personnel familiar with CEMS requirements. A CEMS paperwork and data entry time per maintenance action of 15 minutes was estimated based on conversations with Ms. Barbara Jones (Little Rock AFB). The projected number of maintenance actions for FY94 through FY98 were provided by the SA-ALC Actuarial Staff. The time per maintenance action was multiplied by the projected number of removals for each year to obtain a total time required by year. This total annual time was then multiplied by an average labor rate (E-5) to estimate annual costs. The average time per maintenance action estimate was confirmed as reasonable by Mr. Thibodeau, the T56 engine manager at Pope AFB. All estimates were reviewed with Mr Ken Scribner, SA-ALC/LPEBT. The results of the estimate are presented in Table 2.4-7.

It is also important to note that the proposed CAMS-CEMS Interface (CCI) was considered. However, since implementation is estimated to be years away, the impact of this interface was not included in the estimate. More specifically, the cost associated with this element would stop when the CCI is implemented because CCI would provide a direct link from CAMS to CEMS, eliminating any duplicate CAMS/CEMS paperwork or data entry. In addition the Recurring Training cost element discussed later in this section would also be

reduced, if not completely eliminated. Because the impact of the CCI would be significant, an alternate cost estimate that includes CCI implementation is provided in Appendix A.

Table 2.4-7 O&S Maintenance Labor - Scheduled and Unscheduled CEMS Data Entry

Source	Element	FY94	FY95	FY96	FY97	FY98
Actuarial Staff	Annual Number Maintenance Actions (all PLT items)	2,811	2,739	2,448	2,148	2,084
Ms. BJones (Eng Mgr-LRAFB)	Per MA-Manhours (added) for CEMS data entry, paperwork, etc.	0.25	0.25	0.25	0.25	0.25
Ms. BJones (Eng Mgr-LRAFB)	Per MA-Manhours (subtracted) for CAMS data entry, paperwork, etc.	0	0	0	0	0
	Net Manhour Increase	0.25	0.25	0.25	0.25	0.25
	Net Annual Manhour Increase	702.75	684.75	612	537	521
Ms. BJones/ AFR 173-13	Hourly Labor Rate (E-5)	$21.54	$21.54	$21.54	$21.54	$21.54
	Annual Cost Increase — FY93 Dollars	$15,137	$14,750	$13,182	$11,567	$11,222

2.4.1.6 Recurring CEMS Costs

This cost element was analyzed based on the expectation that there will be a fee for using CEMS. The cost element addresses any recurring cost for the J85 to use CEMS, including such costs as computer usage, communication lines, and system changes. After discussions with Mr. Streller (CEMS PMO) it was decided that this element should not be considered at this time. It is anticipated that a fee for service will be implemented in FY95 or later timeframe. However, insufficient details are available at this time to cost this impact.

2.4.1.7 Documentation Maintenance

This cost element was included to address any new documentation added as a result of the implementation of J85 PLT in CEMS. However, as discussed under the Documentation Implementation cost element, the amount of new documentation will be minimal. As

a result, the recurring costs associated with this element for J85 CEMS PLT will be minimal as well.

2.4.1.8 Recurring Training

Recurring Training includes the annual cost to train J85 personnel to use CEMS for PLT. As discussed under initial training, the only costs associated with training are per diem and travel costs to Tinker AFB (rental cars are not authorized). This cost element was estimated using a base level attrition rate obtained from AFMC Pamphlet 173-10. This rate was multiplied by the initial training cost estimate to estimate annual recurring training costs which begin in FY95. The results of the estimate are provided in Table 2.4-8.

Table 2.4-8 Recurring Training

Source		FY94	FY95	FY96	FY97	FY98
AFR 173-10	Total Initial Training Cost	N/A	$17,497	$17,497	$17,497	$17,497
	Attrition Rate (Base Maint. Personnel)	0.1787	0.1787	0.1787	0.1787	0.1787
	Annual Recurring Training Costs for CEMS	$0	$3,127	$3,127	$3,127	$3,127

2.4.1.9 Cost Summary

Table 2.4-9 summarizes the costs to implement J85 PLT in CEMS for J85. The costs, in Fiscal Year 1993 dollars, are divided into two parts, Implementation and O&S. The Implementation Costs are the one-time (non-recurring) costs associated with the J85 PLT implementation in CEMS, such as Software Investment, Initialization, and Initial Training. The O&S Costs include the annual recurring cost to maintain J85 PLT in CEMS, Maintenance Labor (CEMS data entry) and Recurring Training. The decreasing cost trend in the subsequent years is partially the result of the decrease in the projected number of maintenance actions used in the Maintenance Labor (CEMS data entry) estimate.

Table 2.4-9 J85 Cost Summary (FY93 Dollars)

	FY94	FY95	FY96	FY97	FY98
Implementation Costs					
Software Investment	$10,395				
Initialization	$1,386				
Initial Training	$17,497				
Subtotal — Implementation Costs	**$29,278**				
O&S Costs					
O&S Maintenance Labor (CEMS)	$15,137	$14,750	$13,182	$11,567	$11,222
Recurring Training		$3,127	$3,127	$3,127	$3,127
Subtotal — O&S Costs	**$15,137**	**$17,877**	**$16,309**	**$14,694**	**$14,349**
Total Costs Incurred	**$44,415**	**$17,877**	**$16,309**	**$14,694**	**$14,349**

2.4.2 Benefit Analysis and Results

The first step in the Benefit Analysis included the compilation of the potential operational and non-quantifiable cost avoidance benefits that SA-ALC/LPEBT could recognize as a result of the implementation of J85 PLT in CEMS. Appendix B contains a list of potential benefits derived from conversations with personnel at SA-ALC, J85 bases and MAJCOMS.

Of the potential benefits listed in Appendix B, only one was considered readily quantifiable. This benefit is associated with the quarterly requirements forecasting process performed by SA-ALC. Figure 2.4-1 outlines the current requirements forecasting process performed using CAMS data. Under this process SA-ALC requests information from the using commands (AFMC, ATC, and ACC). AFMC and ACC provide SA-ALC with requirement quantities by fiscal year, which SA-ALC incorporates into their requirements calculations. However, because of the magnitude of information they must manage, ATC

provides only a generic CAMS report (-18P) to SA-ALC. While this report includes all the information required for SA-ALC to develop the forecast, they must perform an extensive amount of data manipulation before the actual requirements can be calculated. Once SA-ALC has identified the initial requirements, they are reviewed and adjusted by the Item Manager. After the Item Manager completes any necessary adjustments, the Financial Management community reviews and validates the requirements before they are sent to Procurement.

Estimates of the manhours required to complete the requirements forecasting process are listed at the bottom of Fig. 2.4-1. The Determine Initial Requirements Block (A) includes a one-time effort of 404 manhours to develop and populate a database to store the CAMS -18P data received from ATC in a more usable form. Without this database, the translation task would become very labor intensive and the time-frame required unacceptable given the requirement for SA-ALC to perform this task on a quarterly basis.

Other steps in the process are also estimated. A total of 200 hours are identified for a GS-09 to update the database on a quarterly basis, and 32 hours are provided for a GS-12 to develop the actual requirements forecast. Sixteen GS-11 hours are provided for the Item Manager adjustment, and an additional eight GS-12 hours are provided for the Financial Management task. A detailed breakdown of the manhour estimates is provided in Table 2.4-10.

The primary sources of these data were Mr. Ken Scribner (SA-ALC/LPEBT) and Major Bauer (Hq ATC). Mr. Scribner provided a description of the requirements forecasting process used to developed the process flow diagrams in Figs. 2.4-1 and 2.4-2. He also estimated the manhours required to perform each task with the exception of the CAMS Block A — Create Database and Load Data task, and the CAMS Block A — Quarterly Data Update task. Major Bauer provided the estimates for these two tasks.

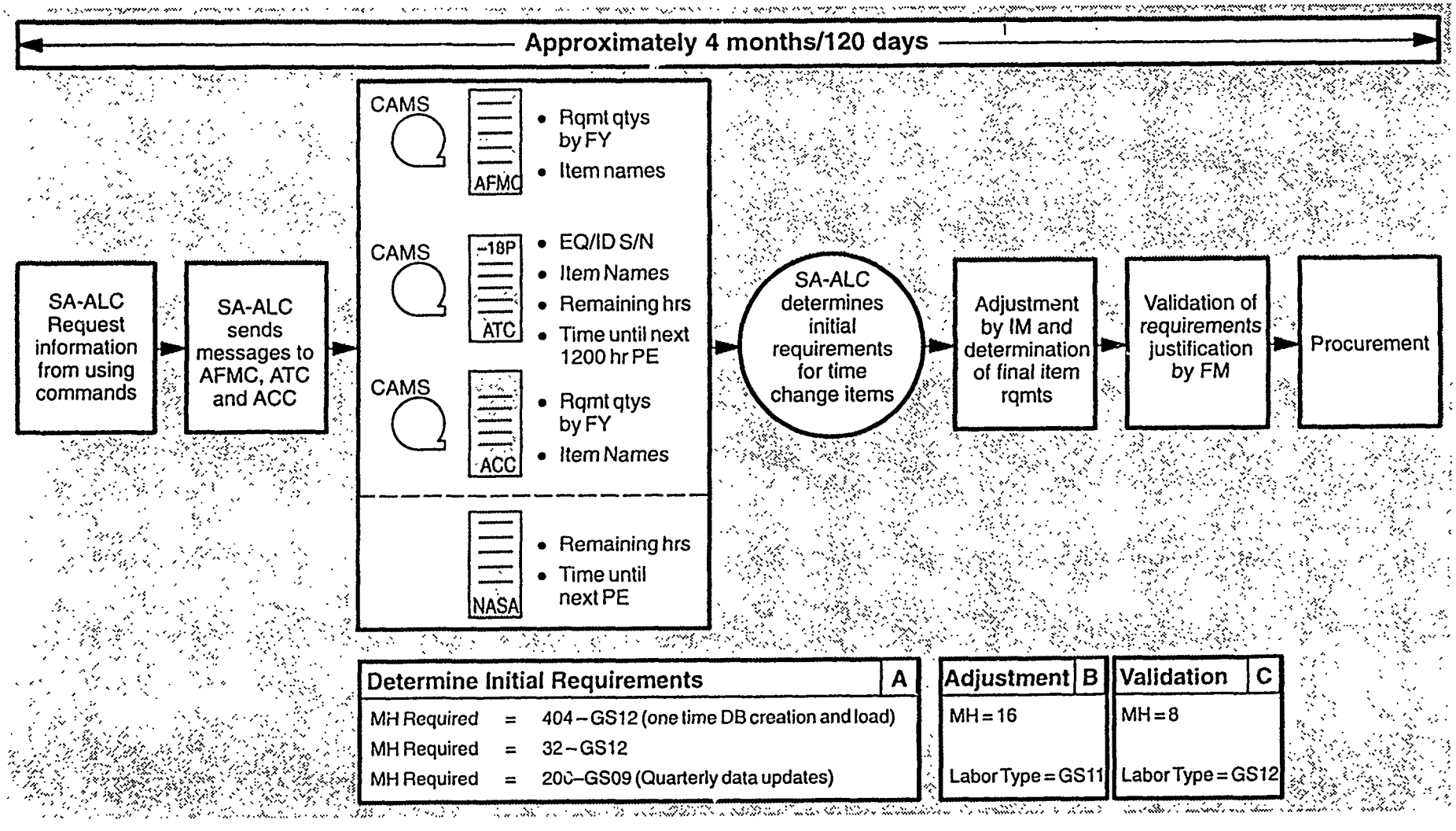

Figure 2.4-1 Quarterly Forecasting Using CAMS

Table 2.4-10 Annual Process Cost Using CAMS

Block A — Determine Initial Requirements	Detail		Summary	
1) Create Database for ATC data (One-Time Cost)	(23 PLT Items)* 1348 ATC Engines	31,004	Total Manhours (GS-12)	404
	Minutes/record (40 seconds)	0.67	Labor Rate (GS-12)	$34.65
	Total Minutes	20,773	One-Time Database Cost	**$13,999**
	Total Manhours (GS-12)	346		
	Breaktime per MHr of Data Entry			
	Minutes (10 min * 346 MHrs)	3,460		
	Manhours (Minutes/60)	58		
	Total Manhours (GS-12)	404		
2) Update database and Determine Requirements (Quarterly) (Note: All records will be updated *each quarter — includes spares* and installed engines. Potential fields to be updated include: Part No. (15 char.), Serial Number (15 char.), Engine SN (6 char.), Base (3 char.), and COT (5 char.).)	No. of Records (23 Items * 1348 ATC eng.)	31,004	Total Manhours (GS-09)	800
	Minutes/Record (20 seconds)	0.33	Labor Rate (GS-09)	$23.36
			Annual Update Cost (GS-09)	**$18,688**
	Total Minutes Per Quarter	10,231		
	Total Manhours Per Quarter	171		
	Breaktime MHrs/Quarter (10 min/hr)	29		
	Annual MHr Requirement (GS-09)	800		
	Analysis time required to convert database information into requirements quantities		Total Manhours (GS-12)	128
			Labor Rate (GS-12)	$34.65
			Annual Analysis Cost (GS-12)	**$4,435**
	Total Analysis Time/Quarter	32		
	Annual MHr Requirement (GS-12)	128		
	Total Annual Update and Analysis Cost		Total Update & Analysis	**$23,123**
	Total Block A Cost			**$37,122**
Block B — Adjustments	Total Manhours/Quarter	16	Total Manhours (GS-11)	64
	Annual Manhours Required (GS-11)	64	Labor Rate (GS-11	$28.48
	Total Block B Annual Cost			**$1,823**
Block C — Validation	Total Manhours/Quarter	8	Total Manhours (GS-12)	32
	Annual Manhours Required (GS-12)	32	Labor Rate (GS-12)	$34.65
	Total Block C Annual Cost			**$1,109**

Table 2.4-10 Annual Process Cost Using CAMS (Continued)

Block A — Determine Initial Requirements	Detail	Summary
Total Using CAMS (FY94), Blocks (A + B+ C)		$40,054
Total Using CAMS (FY95), Blocks (A2 + B + C)		$26,055

The time required for the Create Database and Load Data task is driven by the time to populate the database. The estimate for this task (404 manhours) is based on the total number of records required to be loaded into the database. The number of records was calculated by multiplying the number of ATC aircraft (1348) by the number of PLT items per aircraft (23). The total manhours required was calculated by multiplying the total number of records by an estimate of the average number of minutes required for each record (.67 minutes, or 40 seconds). This 40-second time per record equates to .9 second per character (40 seconds/44 characters per record). The character count is composed of the part number (15 characters), serial number (15 characters), engine serial number (6 characters), base (3 characters), and the current operating time (5 Characters) for a total of 44 characters. In addition, the estimate allows for a 10 minute break per manhour of data entry.

The estimate of .9 seconds per character includes both data entry and validation. The Guideline for Designing User Interface Software, prepared by the Mitre Corporation, Bedford, MA (Reference C6e), suggests the use of a standard data entry time per character of .2 seconds. However, as the Mitre study points out, this standard does not take computer response time or human validation time into consideration. Therefore, to provide for these two factors, the .9 second average time per character estimate was considered reasonable.

Major Bauer's estimate of the manhours required to update the database on a quarterly basis is 200 manhours. This estimate was developed using the same methodology as that used for the initial data load (number of aircraft multiplied by the number of PLT items per aircraft multiplied by the data entry time per character multiplied by the number of characters). However, it is likely that many of the fields in each record will not have to be updated each quarter (e.g., part number, serial number, etc.). To account for this, the estimate assumes the time required to update a record will be one-half of the time required to initially load the record, or .33 minutes (40 seconds/2 = 20 seconds).

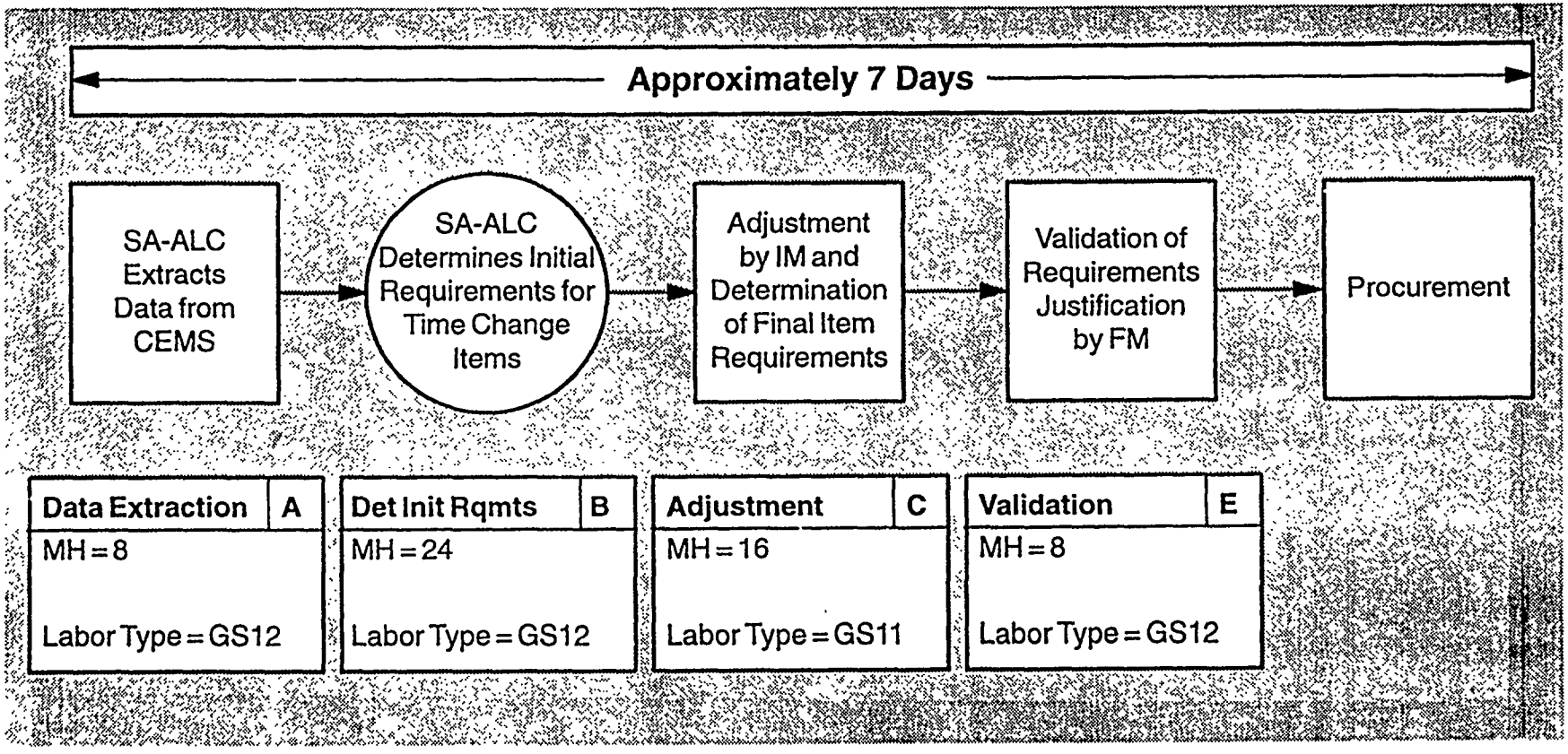

Figure 2.4-2 Requirements Forecasting Using CEMS

Figure 2.4-2 outlines the requirements forecasting process using CEMS. The CEMS process eliminates many of the steps required under CAMS. The entire process consists of four steps. SA-ALC signs on to CEMS and extracts the necessary data (A). These data are then used to determine the initial requirements (B). The Item Manager performs the necessary adjustments (C), and the Financial Management community validates the requirements (D), before they are sent to Procurement. As shown in Fig. 2.4-2, the entire process should take approximately 7 days. In comparison with the CAMS four-month process, the CEMS process will result in a time savings of over three and one-half months. Table 2.4-11 provides a detailed outline of the cost estimate calculation. Table 2.4-12 provides a cost savings calculated by comparing the costs of the two processes. The greatest benefit associated with implementing J85 PLT in CEMS is the elimination of voluminous manual data entry in support of the requirements forecasting process.

Table 2.4-11 Annual Process Cost Using CEMS

Block A — Extract Data From CEMS	Manhours/Year (GS-12) Labor Rate (GS-12) Block A Annual Cost	32 $34.65 $1,109
Block B — Determine Initial Requirements	Manhours/Year (GS-12) Labor Rate (GS-12) Block B Annual Cost	96 $34.65 $3,326
Block C — Adjustments	Manhours/Year (GS-11) Labor Rate (GS-11) Block C Annual Cost	64 $28.48 $1,823
Block D — Validation	Manhours/Year (GS-12) Labor Rate (GS-12) Block D Annual Cost	32 $34.65 $1,109
Total Using CEMS		$7,367

Table 2.4-12 Benefit Summary

	FY94	FY95	FY96	FY97	FY98
CAMS Process	$40,054	$26,055	$26,055	$26,055	$26,055
CEMS Process	$7,367	$7,367	$7,367	$7,367	$7,367
Total Costs Incurred	$32,687	$18,688	$18,688	$18,688	$18,688

2.5 COST/BENEFIT SUMMARY

The costs incurred and cost savings presented in Paragraph 2.4 are summarized in Fiscal Year 1993 Dollars in Table 2.5-1. The cost summary is inflated to then-year dollars in Table 2.5-2. *The results show that, after FY94, where initial start-up costs are incurred, the benefit savings outweigh the costs incurred.*

Table 2.5-1 Cost Summary (FY93 Dollars)

	FY94	FY95	FY96	FY97	FY98
Total Costs Incurred #	$44,415	$17,877	$16,309	$14,694	$14,349
Benefits — Costs Savings * (Other Manhours/Labor)	$32,687	$18,688	$18,688	$18,688	$18,688
Net Annual Cost Savings	($11,728)	$811	$2,379	$3,994	$4,339

Total Costs Incurred from Table 2.4-9
* Cost Savings from Table 2.4-12

Table 2.5-2 Cost Summary (Then-Year Dollars)

	FY94	FY95	FY96	FY97	FY98
Weighted Inflation Index	1.032	1.066	1.100	1.135	1.172
Total Costs Incurred	$45,836	$19,057	$17,940	$16,678	$16,817
Benefits — Costs Savings (Other Manhours/Labor)	$33,733	$19,921	$20,557	$21,211	$21,902
Net Annual Cost Savings	($12,103)	$864	$2,617	$4,533	$5,085

Note: To simplify the Then-Year calculation, Appropriation 3400 Indices were used — even though a small portion of the costs incurred were for Military Pay (Apn. 3500).

3. SUMMARY

Life limited parts tracking is an essential engine management function that must be performed on the J85. Currently the J85 performs this function using CAMS (G054). SA-ALC/LPEBT, with the support of the using commands, is evaluating the feasibility of converting the J85 PLT activity to CEMS (D042).

3.1 FINDINGS

The analysis performed under this effort revealed that the CAMS (G054) is adequate for base level uses, however, because it does not feed the PLT information into a central database accessible by major command and depot personnel it does not meet all the needs of the J85 engine community. Hq ATC developed a command unique CAMS application that allowed J85 PLT records to be extracted from the G054 database and transferred to a PC for analysis and local manipulation. However, a recent change to the G054 database structure rendered this special application unworkable. Hq ATC and SA-ALC must now rely on manual data collection and analysis for J85 parts forecasting until this problem can be resolved. In the long term, SA-ALC must use a manual approach, fund a permanent revision to CAMS, or convert to another data system. Time is a factor in this decision because of a requirement to forecast parts requirements quarterly. The process flow diagram, Fig. 2.4-1, indicated that it takes approximately 3 1/2 months to do the forecast manually, thereby, making the manual solution unacceptable. The option of funding a permanent J85 modification to the G054 is not recommended as it would duplicate functionality that currently exists in the CEMS (D042).

The most viable solution to this problem appears to be for the J85 to use another data system for PLT. The D042 already has the basic functionality for parts tracking and can incorporate the J85 requirements for a very modest software investment cost (a little over $10,000). Initial CEMS training is the largest single cost element of implementing J85 PLT in CEMS. A breakout of the training cost was provided in Table 2.4-6. The numbers

shown in this table assume that no one on the J85 program at the identified locations have had CEMS training. However, during the field visits it was noted that most locations already have a number of people that have had the necessary training. Table 3.1-1 is a summary of the modest costs associated with implementing J85 PLT in CEMS.

Table 3.1-1 J85 PLT Implementation in CEMS Cost Summary (FY93 Dollars)

	FY94	FY95	FY96	FY97	FY98
Implementation Costs					
Software Investment	$10,395				
Initialization	$1,386				
Initial Training	$17,497				
Subtotal — Implementation Costs	**$29,278**				
O&S Costs					
O&S Maintenance Labor (CEMS)	$15,137	$14,750	$13,182	$11,567	$11,222
Recurring Training		$3,127	$3,127	$3,127	$3,127
Subtotal — O&S Costs	**$15,137**	**$17,877**	**$16,309**	**$14,694**	**$14,349**
Total Costs Incurred	**$44,415**	**$17,877**	**$16,309**	**$14,694**	**$14,349**

Overall this study indicated that implementing J85 PLT in CEMS is feasible and promotes proactive logistics management. The change to the D042 (CEMS) system will also result in cost savings over time. In addition to the cost savings, the J85 program should also realize other significant non-quantifiable benefits. J85 processes, such as requirements forecasting, will be streamlined and result in improved asset visibility and efficiency. An increase in effectiveness is also expected as a result of improved communication between the MAJCOMs and SA-ALC. Another key benefit that is expected to be achieved by the use of the D042 for J85 PLT is improved fleet safety. This safety improvement is expected to be achieved by expediting the evaluation of life limit changes on J85 components thus precluding the unintentional operation of engines containing components that exceed life limits.

The one negative factor in the use of the CEMS (D042) is that it will not reduce the data entry requirements for CAMS (G054). The duplicate data entry will continue to exist until an electronic interface is established between CAMS and CEMS. Once the CAMS-CEMS interface (CCI) is achieved the duplicate data entry problem will be eliminated. As seen in Appendix A implementation of CCI will result in even greater cost savings for the J85 community.

The results of this study support the proposed action to change the system used for J85 parts tracking from the G054 (CAMS) to the D042 (CEMS). Recommend appropriate action be initiated to obtain formal authorization for the CEMS Program Office to proceed with the necessary programming action required to modify the D042 system for J85 PLT.

3.2 FUTURE CONSIDERATIONS

During this study the following two areas were identified for possible future evaluation:

1. The J85 maintenance concept is a modified two-level approach with most maintenance being performed at base level. The J85 PLT implementation in CEMS provides an opportunity to identify potential data system problems that may be encountered when other engines move to a two-level maintenance concept. Identification and documentation of any implementation problems will provide lessons learned for the other engine programs.

2. The proposed CAMS/CEMS interface (CCI) being evaluated by the CAMS Program Office plans to use CAMS (G054) to update CEMS (D042). However, a more cost effective approach might be to use CEMS to update CAMS. An investigation of this alternative approach is suggested.

APPENDIX A

ALTERNATE COST ESTIMATE - WITH CCI INCLUDED

APPENDIX A

ALTERNATE COST ESTIMATE - WITH CCI INCLUDED

This appendix provides an alternate cost/benefit estimate based on the assumption that the CAMS-CEMS Interface (CCI) will be implemented at the end of Fiscal Year 1995. The CCI will eliminate duplicate data entry by populating the CEMS through an interface with CAMS. All data entry will be done through CAMS. When the CCI is implemented the maintenance labor costs associated with CEMS PLT data entry and related recurring CEMS-training will be eliminated. The estimate is summarized in three Tables. Table A-1 provides the costs expected to be incurred from FY94 through FY98. Note that these costs differ from the primary estimate only in that the Maintenance Labor (CEMS) and Recurring Training Costs stop after FY95. Tables A-2 and A-3 incorporate this alternate cost estimate into the overall cost benefit summary. Table A-2 presents the summary in Base Year 1993 Dollars and Table A-3 presents the summary in Then-Year Dollars.

Table A-1 Alternate Cost Summary (CCI Implemented at the end of FY95)

	FY94	FY95	FY96	FY97	FY98
Implementation Costs					
Software Investment	$10,395				
Initialization	$1,386				
Initial Training	$17,497				
Subtotal — Implementation Costs	**$29,278**				
O&S Costs					
O&S Maintenance Labor (CEMS)	$15,137	$14,750			
Recurring Training		$3,127			
Subtotal — O&S Costs	**$15,137**	**$17,877**	**$0**	**$0**	**$0**
Total Costs Incurred	**$44,415**	**$17,877**	**$0**	**$0**	**$0**

Table A-2 Alternate Cost/Benefit Summary (CCI Implemented at the end of FY95)
Base Year 1993 Dollars

	FY94	FY95	FY96	FY97	FY98
Total Costs Incurred #	$44,415	$17,877	$0	$0	$0
Benefits — Costs Savings * (Other Manhours/Labor)	$32,687	$18,688	$18,688	$18,688	$18,688
Net Annual Cost Savings	($11,728)	$811	$18,688	$18,688	$18,688

Total Costs Incurred from Table A-1
* Cost Savings from Table 2.4-12

Table A-3 Alternate Cost/Benefit Summary (CCI Implemented at the end of FY95)
Then-Year Dollars

	FY94	FY95	FY96	FY97	FY98
Weighted Inflation Index	1.032	1.066	1.100	1.135	1.172
Total Costs Incurred	$45,836	$19,057	$0	$0	$0
Benefits — Costs Savings (Other Manhours/Labor)	$33,733	$19,921	$20,557	$21,211	$21,902
Net Annual Cost Savings	($12,103)	$864	$20,557	$21,211	$21,902

Note: To simplify the Then-Year calculation, Appropriation 3400 Indices were used — even though a small portion of the costs incurred were for Military Pay (Apn. 3500).

APPENDIX B

POTENTIAL BENEFITS OF PERFORMING J85 PLT IN CEMS

APPENDIX B

POTENTIAL BENEFITS OF PERFORMING J85 PLT IN CEMS

Several non-quantifiable benefits associated with performing J85 PLT in CEMS were identified based on discussions with J85 and CEMS personnel. This Appendix list these benefits which together should allow J85 to improve efficiency by streamlining processes, increase effectiveness through the centralized real-time visibility into key engine metrics, and enhance the capability to support fleet safety by facilitating the expeditious implementation of life-limited component changes. The benefits identified are as follows:

- Streamlined data flow process used in forecasting requirements will result in a process time reduction.
- Centralized real-time visibility into key engine and module metrics (e.g., age distribution, etc.) to evaluate the impacts on serial numbered components.
- Central CEMS database facilitates expanded use of data (e.g., tailored software applications, etc.).
- Expeditious implementation of a critical component change will result in improved aircraft safety by facilitating the elimination of aircraft flying with installed parts which are beyond their life limits.
- Real time data ensures replenishment spares are bought on time to support established readiness/availability goals.
- Improved communication among SA-ALC, MAJCOMS, and bases.
- MAJCOM, SA-ALC, and base engine managers can perform logistics analyses and evaluate programs/policies using the identical data source.

APPENDIX C

REFERENCES AND APPLICABLE DOCUMENTS

APPENDIX C

REFERENCES AND APPLICABLE DOCUMENTS

C.1 PROJECT DOCUMENTATION

a. TASC Slide Presentation (SP-6760-1-2), "J85 Engine Cost/Benefit Study - Baseline Definition and Methodology Recommendation," 18 February 1993.

b. TASC Slide Presentation (SP-6760-1-4), "J85 Engine Cost/Benefit Study - Analysis Results," 21 April 1993.

C.2 REGULATIONS AND MANUALS

a. AFM 400-1, Vol. I, 9 January 1989, "Selective Management of Propulsion Units Policy and Guidance."

b. AFR 400-1, Vol. III, 30 March 1990, "Selective Management of Propulsion Units Policy, Responsibilities, and Procedures for Computing Requirements for Spare Engines and Modules."

c. AFM 66-279, Vol III, 1 October 1990, "Equipment Maintenance, Core Automated Maintenance System (CAMS) GO54, Comprehensive Engine Management System (CEMS) D042 Users Manual."

C.3 TECHNICAL ORDERS

a. TO 2J-J85-113-5S-75 "Depot Maintenance Manual, Cleaning, Inspection, and Overhaul, Turbojet Engine Models J-85-GE-5H, J-85-GE-5J, J-85-GE-5K, and J-85-GE-5L," June 1988/Change 3 July 1984.

b. TO 2J-J85-113-9S-3 "Depot Maintenance Manual, Minor Accessories Overhaul, Turbojet Engine Models J-85-GE-5C, J-85-GE-5D, J-85-GE-5E, J-85-GE-5F, J-85-GE-5G, J-85-GE-5H, J-85-GE-5J, J-85-GE-5K, and J-85-GE-5L," June 1983/Change 6 January 1992.

c. TO 2J-J85-116-5 "Intermediate Maintenance Manual, Cleaning, Inspection, and Repair, Turbojet Engine Models J-85-GE-5H, J-85-GE-5J, J-85-GE-5K, and J-85-GE-5L," June 1980

d. TO 00-20-5-1-X, undated, "Draft Technical Manual - Instructions on Jet engine Parts Tracking and Historical Records for the J85 Series Engine."

e. TO 00-25-254-1 "Supplemental Manual, Draft - Comprehensive Engine Management Systems (CEMS) (D042) Engine Status, Configuration and TCTO Report, Procedures."

C.4 AUDIT REPORTS

a. Air Force Audit Agency Report of Audit, "Review of Maintenance Concepts for Overhauling Aircraft Engines," Project 7106213, 3 July 1989.

C.5 COST DOCUMENTS

a. AFR 173-13, 31 March 1993, "US Air Force Cost and Planning Factors," Air Force Worldwide Financial Management System (On-Line).

b. AFMCP 173-10, 31 March 1993, "AFMC Cost and Planning Factors," Air Force Worldwide Financial Management System (On-Line).

c. National Estimating Society (NES), Fall 1986, "NES Dictionary of Cost Estimating Terms."

C.6 OTHER MISCELLANEOUS DOCUMENTS

a. SA-ALC/LPED Briefing, undated, "Comprehensive Engine Management System (CEMS)."

b. SA-ALC/LPEBL Briefing, 31 October 1992, "J85-5 Engine Management Report Briefing."

c. J85 Communications-Computer Systems Requirements Document (CSRD) AFLC-HQTR-88-0021-A-1-PNA-ISR, 6 February 1990 and Attachment 1 dated 12 February 1991, revised 10 April 1991.

d. HQ ATC/LG Message, 031530 December 1990, "J85 Engine Parts Tracking."

e. Guidelines for Designing User Interface Software prepared by MITRE Corporation, Bedford MA for Deputy Commander for Development Plans and Support Systems, Electronic Systems Division, AFSC, USAF, Hanscom AFB, MA. Sidney L. Smith and Jane N. Mosier. ESD-TR-86-278, August 1986.

f. SA-ALC/LPE/MMP Message, 6 February 1990, "J85 Communications - Computer Systems Requirements Document (CSRD) AFLC-HQTR-88-0021-A-1-PNA-ISR."

APPENDIX D

ABBREVIATIONS AND ACRONYMS

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ABBREVIATIONS AND ACRONYMS

ACC	Air Combat Command
AFAA	Air Force Audit Agency
AFB	Air Force Base
AFCAA	Air Force Cost Analysis Agency
AFMC	Air Force Materiel Command
AFMCP	Air Force Materiel Command Pamphlet
AFMCR	Air Force Materiel Command Regulation
AFR	Air Force Regulation
AFTO	Air Force Technical Order
ALC	Air Logistics Center
APPN	Appropriation
ATC	Air Training Command
CAMS	Core Automated Maintenance System
CCI	CAMS-CEMS Interface
CEMS	Comprehensive Engine Management System
CIP	Component Improvement Program
CSRD	Communications-Computer System Requirements Document
DAFB	Dyess Air Force Base
DB	Database
DoD	Department of Defense
EOQ	Economic Order Quantity
EQ	Equipment
FHR	Flying Hour
FM	Financial Management
FMS	Foreign Military Sales
FY	Fiscal Year

HQ	Headquarters
ID	Identification
IM	Item Manager
JEIM	Jet Engine Intermediate Maintenance
LRAFB	Little Rock Air Force Base
MA	Maintenance Action
MAJCOM	Major Command
MHR	Manhour
MIL-STD	Military Standard
MOT	Maximum Operating Time
NES	National Estimating Society
NSN	National Stock Number
O&S	Operation and Support
OC	Oklahoma City
OCM	On Condition Maintenance
OH	On Hand
OSD	Office of the Secretary of Defense
PLT	Parts Life Tracking
PMO	Program Management Office
R&R	Remove and Replace
RCMA	Reliability-Centered Maintenance Analysis
RCM	Reliability-Centered Maintenance
SA	San Antonio
SATO	Scheduled Airlines Travel Office
SN	Serial Number
SP	Slide Presentation
STG	Stage
SW	Software
TAFBR	Tinker Air Force Base Regulation
TO	Technical Order

TY	Then-Year
USAF	United States Air Force